

State of California
The Resources Agency
Department of Fish and Game

**THE RECOVERY OF TROUT
IN LITTLE LAST CHANCE CREEK,
PLUMAS COUNTY FOLLOWING
AN APPLICATION OF ROTENONE IN 1991**

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INTRODUCTION

The Department of Fish and Game (DFG) poisoned the waters of Frenchman Reservoir and Little Last Chance Creek (Figure 1) with rotenone in 1991 to kill northern pike (Esos lucius) that had been illegally introduced into those waters. Rotenone is often used to eliminate undesirable fishes from lakes and streams. For example, the DFG has used rotenone to eliminate brown bullhead (Amerius nebulosis) and green sunfish (Lepomis cyanellus) from Antelope Reservoir, and northern pike from Frenchman Reservoir, Little Last Chance Creek, Lake Davis, Big Grizzly Creek, and parts of the Feather River in Plumas County (Rischbieter 1998).

We have been able to provide information on standing stocks, age, growth, and condition of trout in Little Last Chance Creek before and after treatment because we sampled this creek as part of another program. The Department of Water Resources (DWR) initiated an instream flow program in 1976 to identify streams that would benefit from flow enhancement and to assess instream values. The Northern District of the DWR selected Little Last Chance Creek below Frenchman Reservoir as one of the streams to study. The DFG studied trout populations in Little Last Chance Creek in 1976, 1981, 1986, 1988, and 1991 through 1997. Brown trout (Salmo trutta) was the only game fish caught every year.

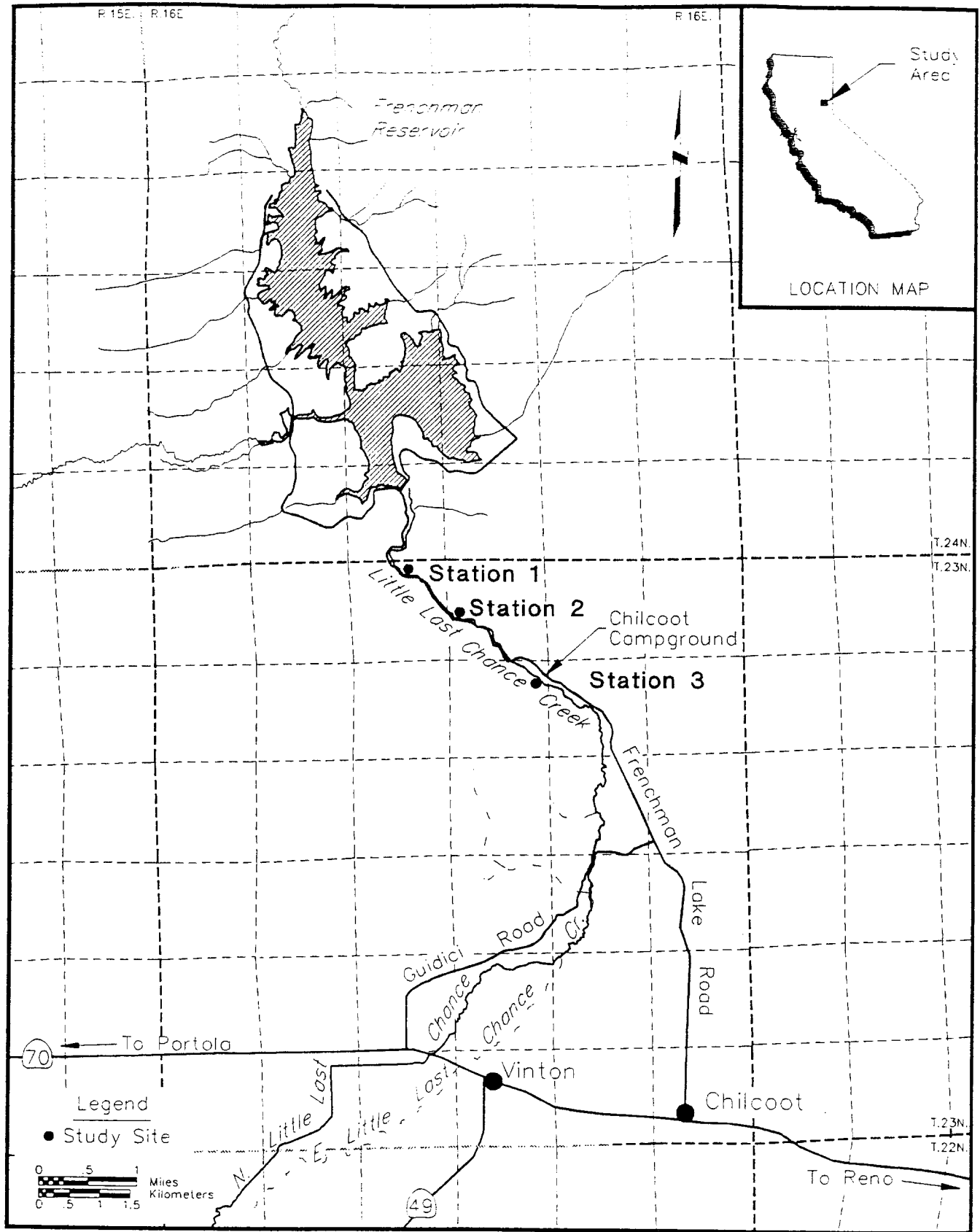


Figure 1. Stations Sampled to Estimate Standing Stocks of Fish in Little Last Chance Creek, Plumas County.

Sacramento suckers (Catostomus occidentalis) were also caught every year (Brown 1976, Bumpass et al. 1989, Brown 1991, Brown 1992a, Brown 1992b, Brown 1993, Brown 1994, Brown 1995, Brown 1996, Brown 1997, and Brown 1998).

The purpose of this study is to document the effects of rotenone on fishes of Little Last Chance Creek and the recovery of those fishes in the years that followed that treatment.

STUDY AREA

The Little Last Chance study area extends from the stream at the base of Frenchman Dam to below the Chilcoot campground (Figure 1). The stream flows through rocky canyons and forested meadows. Elevation in the study area averages 1632 m. Steep hillsides surrounding the stream are covered with pine, cedar, and fir trees. Trees that border the stream are predominantly alder. Little Last Chance Creek averages 5.3 m in width in the study area.

Stream flow is a combination of releases and spills from Frenchman Reservoir. Reservoir spills can raise flows to high levels January through June. Summer flow is largely comprised of releases from the dam. Flow is typically highest in April and May and lowest in November and December (Table 1). Dissolved oxygen averages 9.5 ppm while pH averages 8.0. Electrical conductivity is 135 while turbidity averages 0.0 FTU (DWR file data).

Table 1. Average annual streamflow (cfs) in Little Last Chance Creek, 1991-1997.

January	23
February	14
March	44
April	68
May	96
June	51
July	37
August	43
September	16
October	5
November	2
December	2

NAMES OF FISHES

The following species of fishes have been caught in this study: rainbow trout (Oncorhynchus mykiss), brown trout, Sacramento sucker, Sacramento pikeminnow (Ptychocheilus grandis), and channel catfish (Ictalurus punctatus), Lahontan reddsides (Richardsonius egregius), and speckled dace (Rhinichthys osculus)

METHODS

Physical Measurements

Standing stocks of fishes were estimated at three stations in Little Last Chance Creek (Figure 1). Stations were intentionally selected to be near stations sampled in previous DFG studies (Gerstung 1973). Markers had previously been placed in trees along the stream to identify station boundaries. Stations varied in length from 37.5 to 67.1 m. The length and width of each station was measured with metric tape measures.

Biological Measurements

Fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983). Captured fish were removed from the net-enclosed section on each pass. Standing stock estimates were developed using the two-

method of Seber and LeCren (1967) or the multiple-pass method of Leslie and Davis (1939) with limits of confidence computed using a formula proposed by DeLury (1951).

The weights of trout and nongame fishes were measured by displacement. Fork length (FL) of each fish caught was measured to the nearest millimeter.

Scale samples were taken from brown trout and rainbow trout over 100 mm in length. Scales were taken just above the lateral line between the dorsal and adipose fin (Scarnecchia 1979) and placed in a piece of paper inserted in a small coin envelope (Drummond 1966). Scales were mounted dry between microscope slides, and their images were projected on a NCR microfiche reader at a magnification of 42x. Scale measurements for the calculation of growth were recorded to the nearest millimeter along the anterior radius of the anterior-posterior axis of the scale. Estimations of instantaneous population growth rates were calculated (Ricker 1975) with significant values of correlation coefficients taken from a table (Steel and Torrie 1960).

$$\text{Instantaneous population growth rate} = b(\log_e l_2 - \log_e l_1)$$

b = between ages functional slope

l_1 = initial length for the last complete year of growth

l_2 = final length for the last complete year of growth

Standing crops of brown trout and rainbow trout were calculated for individual stations where each species was caught and then combined for the entire creek. Age and growth were calculated for the population (Everhart et al. 1975). Length-weight relationships were determined for both brown trout and rainbow trout (Lagler 1956). The coefficient of condition and 95 percent confidence intervals were calculated for all trout (Carlander 1969).

RESULTS AND DISCUSSION

Biomass and Standing Crop

Five estimates of rainbow trout populations between 1976 and 1988, prior to rotenone treatment, averaged 1,714 trout/ha. Biomass of rainbow trout for that same time period averaged 71 kg/ha. Population estimates of rainbow trout averaged 590 trout/ha for the period 1991 through 1997, following treatment. Estimates of rainbow trout biomass were also low following treatment, averaging 22 kg/ha. Population and biomass estimates did not reach pre-treatment levels until 1997 (Table 2). Anglers may have caught most of the catchable rainbow trout planted in 1991 through 1993. The DFG stopped planting catchable rainbow trout in 1993 and only planted fingerling rainbow trout in 1997 (Table 3). The increase in rainbow trout abundance evident in 1996 and 1997 were due to rainbow trout that tumbled down the spillway of Frenchman Dam (pers. obs.) and took up residence in Little Last Chance Creek. Frenchman Lake did not spill in 1991 through 1995.

Table 2. Average standing crop and biomass for brown and rainbow trout in Little Last Chance Creek, 1976-1997.

Year	Rainbow trout		Brown Trout	
	Population Estimate (trout/ha)	Biomass (kg/ha)	Population Estimate (trout/ha)	Biomass (kg/ha)
Before Treatment				
1976	568	139	16	12
1981	798	40	35	27
1986	3608	38	54	37
1988	1881	65	76	55
Average	1714	71	45	33
After Treatment				
1991	0	0	15	2
1992	20	5	21	1
1993	0	0	51	17
1994	0	0	92	106
1995	28	1	34	153
1996	1412	36	130	149
1997	2672	110	91	123
Average	590	22	62	79

Five estimates of populations of brown trout populations between 1976 and 1988, prior to rotenone treatment, averaged 45 trout/ha. Biomass for brown trout that same period averaged 33 kg/ ha. Population estimates of brown trout rose to an average of 62 trout/ha for the period 1991 through 1997, following treatment. Estimates of brown trout biomass also rose following treatment to an average of 79 kg/ha. Estimates of population and biomass averaged less than the pre-treatment average for the first two years following treatment; 1991 and 1992 (Table 2).

Numbers and weight of brown trout increased after treatment because of reproduction and because the DFG planted trout in the creek frequently from 1991 through 1997 (Table 3).

Table 3. Records of trout planting in Little Last Chance Creek following initial treatment with rotenone in June, 1991.

Year	Rainbow Trout		Brown Trout	
	Catchable	Fingerling	Catchable	Fingerling
1991	500	0	1,300	0
1992	1,000	0	0	0
1993	1,540	0	0	3,000
1994	0	0	0	5,240
1995	0	0	1,250	0
1996	0	0	0	3,000
1997	0	1,500	0	1,631

Biomass of rainbow and brown trout in Little Last Chance Creek are higher than average biomass in this geographical area. Gerstung (1973) recorded data from 278 streams in the northern Sierra Nevada Mountains. Trout biomass averaged 45.9 kg/ha. Fifty stations were sampled in the Owens River, in the southern Sierra Nevada (Deinstadt et al. 1985, Deinstadt et al. 1986). Brown trout standing crop averaged 105.9 kg/ha and 3,038 trout/km. Rainbow trout averaged 30.2 kg/ha and 1,620/trout km. Platts and McHenery (1988) reported that brown trout rainbow trout combinations averaged 500 trout/ha and 61 kg/ha in the Rocky Mountain Forest ecoregion, and 4,100 trout/ha and 87 kg/ha in the Sierra Forest ecoregion.

Age

Scales from 183 rainbow trout were examined in the course of these studies. One hundred and thirty-nine were examined prior to the rotenone treatment and 44 were examined after the treatment. The average calculated lengths of rainbow trout at age I were 109 mm FL before treatment and 95 mm FL after treatment. The average calculated lengths of rainbow trout at age II were 185 mm FL before treatment and 191 mm FL after treatment. The average calculated lengths of rainbow trout at age III were 263 mm FL prior to treatment and 303 mm FL after treatment (Table 4).

Table 4. Length (mm FL) of rainbow trout by age in Little Last Chance Creek.

Year	Number of Trout	Weighted Means at Age		
		I	II	III
Before Treatment				
1981	6	108	191	263
1986	69	125	189	
1988	64	94	175	
Average		109	185	263
After Treatment				
1997	44	95	191	303

Prior to the rotenone treatment of Little Last Chance Creek in 1991, populations of rainbow trout we sampled were represented in age 0+, 1+, 2+ age classes each year. In 1976 through 1986, we also caught age 3+ rainbow trout (Table 5).

After treatment, we caught five rainbow trout that were planted by the DFG or moved downstream over Frenchman Dam from 1992 through 1994. We found one age 0+ rainbow trout in 1995, indicating that some reproduction occurred in 1995. Rainbow trout were represented in age 0+ through 4+ groups in 1996 and 1997. Some of these rainbow trout were the result of natural reproduction and some were planted by the DFG (Table 3). Age distribution of rainbow trout had returned to pre-treatment levels by 1996 (Table 5).

Seventy-one brown trout scales were read for age determination prior to treatment and 78 were read after treatment. The average calculated length of brown trout at age I was 128 mm FL before and 89 mm FL after treatment. The average calculated length of brown trout at age II was 232 mm FL before treatment and 185 mm FL after treatment. The average calculated length of brown trout at age III was 289 mm FL before treatment. The average calculated length of brown trout at age III was 280 mm FL after treatment (Table 6).

Brown trout from Little Last Chance Creek are significantly larger at ages II and III than the average of brown trout from west slope Sierra Nevada streams both free-flowing streams and streams below dams of similar habitat sampled by the DFG (Snider

and Linden 1981). Brown trout from this area were 105 mm FL at age I, but only 163 mm at age II and 210 mm at age III. Lengths of age IV trout were not reported. Brown trout from Little Last Chance Creek are more typical in size at each age class to trout from streams that flow down the east slope of the Sierra Nevada mountains. Brown trout from the east slope were 108 mm FL at age I, 215 mm at age II and 314 mm at age III.

Table 5. Estimated catch of rainbow trout by age in Little Last Chance Creek.

Year	0+	1+	2+	3+	Total
Before Treatment					
1976	5	23	9	1	38
1981	28	2	1	2	33
1986	2	20	7	1	29
1988	63	48	27		138
After Treatment					
1991					0
1992			2	1	3
1993				2	2
1994					0
1995	1				1
1996	91	4	9	1	105
1997	63	40	19	3	125

Table 6. Length (mm FL) of brown trout at age in Little Last Chance Creek.

Year	Number of Trout	Weighted Means at Age		
		I	II	III
Before Treatment				
1981	17	126	245	311
1986	28	159	257	
1988	26	99	193	274
Average		128	232	289
After Treatment				
1997	78	89	185	280

Prior to the DFG's treatment of Little Last Chance Creek with rotenone, brown trout ages were distributed between 0+ and 3+. Brown trout spawn at age 2+. Successful reproduction was indicated each year by the presence of age 0+ brown trout (Table 7).

After treatment, the DFG planted 1,300 catchable brown trout in 1991 (Table 3). Enough of these trout survived to spawn in fall of 1991 to produce 0+ brown trout we caught in 1992. Reproduction was also successful in 1993. Spawning-size adult trout, age 2+, first appeared in our catch in 1993. From 1993 through 1997 the brown trout population was represented by trout in age 0+, 1+, 2+, and 3+ groups each year. Some of these trout were planted by the DFG and some were due to natural reproduction.

Table 7. Estimated catch by age of brown trout in Little Last Chance Creek.

Year	0+	1+	2+	3+	4+	Total
Before Treatment						
1976			1			1
1981	3	4	4			11
1986	2	19	8			30
1988	42	5	9			63
Average	12	7	6			26
After Treatment						
1992	14					14
1993	9	21	3			33
1994	48	6	15	12	1	82
1995	10	16	66	11	2	104
1996	59	34	21	12		126
1997	11	13	48	6	1	79
Average	25	15	26	7	1	73

Trout live longer than 4 years in Little Last Chance Creek, but most are caught during the angling season (McFadden and Cooper 1962, R. Hinton DWR, personal communication) and others occupy areas such as deep, brushy pools and deep crevasses between boulders that are difficult to electrofish with backpack shockers (Johnson 1965). Sampling outside of established study areas has produced trout in excess of 600 mm FL (Brown 1989).

Growth

Growth of age 1-2 rainbow trout averaged 1.540 during the years 1976, 1981, 1986, and 1988, before rotenone was applied to Frenchman Reservoir and Little Last Chance Creek. Growth of age 2-3 rainbow trout was 0.737 in 1976 (Table 8). Scales from age 2-3 rainbow trout were not available for other pre-project years.

Table 8. Growth of rainbow trout and brown trout in Little Last Chance Creek.

	Rainbow Trout		Brown Trout	
	Age 1-2	Age 2-3	Age 1-2	Age 2-3
Before Treatment				
1976	1.285	0.737		
1981	1.737		2.154	
1986	1.240		1.500	
1988	1.897		2.064	1.083
After Treatment				
1997	2.229	1.243	2.208	1.400

Growth of rainbow trout in 1997, after rotenone treatment, was 2.229 for age 1-2 trout and 1.243 for age 2-3 trout (Table 8). Growth was greater after rotenone was applied to Little Last Chance Creek than before. Higher stream flow during the wet years of 1995, 1996, and 1997 (Table 9) created better food production, rearing, and spawning habitat which led to increased growth.

Growth of age 1-2 brown trout, before rotenone treatment, averaged 1.906 for the years 1981, 1986, and 1988. Growth of age 2-3 brown trout in 1988 was 1.083. Age 2-3 brown trout scales were not available for other pre-project years (Table 8).

Growth of brown trout was measured in 1997, after rotenone treatment. Growth was 2.208 for age 1-2 brown trout and 1.400 for age 2-3 brown trout. Growth of age 1-2 and age 2-3 brown trout was greater after the project. Wet years in 1995, 1996, and 1997 (Table 9) created better stream flow conditions which led to better food production and better holding and spawning conditions than pre-project years. Higher flow led to better growth for brown trout.

Table 9. Monthly streamflow (cfs) in Little Last Chance Creek from 1991 through 1997.

	1991	1992	1993	1994	1995	1996	1997
January	2.4	2.0	2.0	2.0	2.0	2.0	151.4
February	2.1	2.0	2.0	2.0	2.0	7.0	79.8
March	8.4	6.8	2.0	2.0	2.0	147.4	138.0
April	4.2	3.6	2.0	16.8	115.4	218.4	113.2
May	35.4	39.9	39.6	30.4	333.5	123.7	66.6
June	35.0	17.2	33.1	44.1	122.5	60.1	46.1
July	28.7	12.9	40.5	28.5	35.5	56.2	54.6
August	12.2	5.4	45.8	26.3	79.1	65.8	68.3
September	5.6	0.3	17.0	6.6	39.4	16.0	27.6
October	2.1	0.3	3.8	2.0	11.1	8.1	7.6
November	2.0	0.3	2.0	2.0	3.8	2.0	3.0
December	2.0	0.3	2.0	2.0	2.0	2.0	3.0

Most growth of trout in Little Last Chance Creek takes place from April to late June. Growth is negligible from December through March. Trout reach their peak condition in June and their lowest condition in fall and winter (Beyerle and Cooper 1960). Growth is controlled by elements of habitat such as stream flow including flooding (Waters 1983, Hansen and Waters 1974, Wesche et al. 1987) water quality such as water temperature (Jowett 1992), conductivity, hardness, and alkalinity (Scarnecchia and Bergersen 1987, Waters et al. 1990), physical components of habitat such as substrate diversity (Scarnecchia and Bergersen 1987), water velocity and undercut banks (Oswood and Barber 1982), deep pools with extensive cover (Lewis 1969), boulders and woody debris (Mesick 1988), and siltation (Waters 1983). Growth is also controlled by the presence of other species (Chapman 1978), stream biota as invertebrate biomass (Jowett 1992), and fishing pressure (Wesche et al. 1987).

Condition Factors

Condition factors of age 0+ through age 3+ rainbow trout averaged 1.1670, 1.0784, 1.0981, and 1.2225 prior to rotenone treatment. Following rotenone treatment condition factors of age 0+ through age 3+ rainbow trout averaged 1.1265, 1.0749, 1.2061, and 1.1538 (Table 10). Condition factors of rainbow trout were comparable between trout that were caught prior to treatment and following treatment.

Condition factors of age 0+ through age 3+ brown trout averaged 1.1499, 1.1429, 1.1608, and 1.1523 before rotenone treatment. After rotenone treatment condition factors of age 0+ through age 3+ brown trout averaged 1.1480, 1.1178, 1.1606, and 1.1851

(Table 10). As with rainbow trout, average condition factors of brown trout prior to treatment and following treatment revealed small differences.

Spawning

We have observed that rainbow trout and brown trout in Little Last Chance Creek do not spawn until they reach about 280 mm fork length (FL). Some of these large trout enter the creek by migrating down the spillway of Frenchman Reservoir. Rainbow trout of this size were uncommon in our catch prior to rotenone treatment and they were uncommon after treatment (Table 11). We caught few large brown trout in 1976, 1981, and 1986, but we caught 11 in 1988. After treatment, we caught few large brown trout in 1991 through 1993, but numbers reached preproject (1988) levels in 1974 through 1997. Some large brown trout were the results of fingerling and catchable brown trout planted by the DFG (Table 3).

Catchable Trout

Catchable trout are trout that are 127 mm FL or larger. Sub-catchable trout are less than 127 mm FL. Prior to treatment rainbow trout average 84 sub-catchable and 39 catchables. After the rotenone treatment, rainbow trout averaged 34 sub-catchables and 15 catchables (Table 3). Few rainbow trout were caught after treatment prior to 1996. Sub-catchable rainbow trout recovered to preproject levels in 1996 and catchable rainbow trout recovered in 1997 (Table 12).

Table 10. Condition factors of rainbow and brown trout in Little Last Chance Creek.

	Rainbow Trout				Brown Trout			
	Age 0+	Age 1+	Age 2+	Age 3+	Age 0+	Age 1+	Age 2+	Age 3+
Before Treatment								
1976	1.1315	1.0492	1.0836				1.0867	
1981	1.1278	1.0985	1.0821	1.2225	1.1351	1.1114	1.2104	
1986	1.2112	1.1131	1.1147		1.1818	1.2068	1.2548	1.1826
1988	1.1975	1.0538	1.1121		1.1328	1.1105	1.0914	1.1219
Average	1.1670	1.0784	1.0981	1.2225	1.1499	1.1429	1.1608	1.1523
After Treatment								
1992			1.4137	0.9635	1.2607			
1993				1.3882	1.1463	1.1020	1.2157	
1994	1.1156	1.0839	1.1591	1.2435	1.1177	1.0902	1.1591	1.2435
1995					1.0957	1.1197	1.1509	1.1640
1996	1.1053	1.0807	1.1655	1.0507	1.1509	1.1426	1.1418	1.2187
1997	1.1585	1.0602	1.0861	1.1230	1.1167	1.1347	1.1355	1.1140
Average	1.1265	1.0749	1.2061	1.1538	1.1480	1.1178	1.1606	1.1851

Most of the sub-catchable rainbow trout caught in 1996 were age 0+ (Table 12). These trout were probably the offspring of rainbow trout that migrated downstream over the spillway of Frenchman Dam and spawned upstream of our study reaches. Sub-catchables caught in 1997 were age 0+ and age 1+ rainbow trout. They were a result of 0+ trout from the 1996 brood year that survived. Rainbow trout fingerlings planted by the DFG in 1997 (Table 3), and migrating rainbow trout that spawned above our study areas.

Table 11. The relative abundance of spawning-size rainbow and brown trout (>280 mm) in Little Last Chance Creek.

Year	Rainbow Trout	Brown Trout
Before Treatment		
1976	0	0
1981	3	0
1986	0	1
1988	1	11
After Treatment		
1991	0	1
1992	1	0
1993	0	1
1994	0	10
1995	0	15
1996	0	12
1997	2	8

Before rotenone treatment, we caught an average of 14 brown trout sub-catchables and 13 catchables. Average numbers of brown trout sub-catchables increased to 25 after treatment while catchable brown trout increased to 39 (Table 12). Few catchable brown trout were caught in 1991 and 1992, but by 1993 catchable brown trout averaged above the preproject average of 13 and stayed above the preproject average through 1997.

This relative abundance is due to favorable streamflow for rearing and spawning in recent years (Table 9), plants of catchable and fingerling brown trout by the DFG (Table 3), and an abundance of spawning-sized (greater than 280 mm) brown trout in 1994 through 1997 (Table 11).

The spawning of these large brown trout is evident by the abundance of age 0+ brown trout in 1994 through 1996 (Table 6).

Table 12. Numbers of sub-catchable (less than 127 mm FL) and catchable (equal to or greater than 127 mm FL) rainbow and brown trout in Little Last Chance Creek.

Year	Rainbow Trout		Brown Trout	
	Sub-catchable	Catchable	Sub-catchable	Catchable
Before Treatment				
1976	7	31	0	1
1981	30	4	6	6
1986	208	81	2	31
1988	91	39	48	14
After Treatment				
1991	0	0	0	1
1992	0	3	14	0
1993	0	0	16	17
1994	0	0	43	39
1995	1	0	12	96
1996	122	2	76	48
1997	116	100	11	69

Streamflow

Haines (1982) conducted an instream flow study on Little Last Chance Creek. She found that low winter flows damage trout because these low flows allow the formation of anchor ice which can keep stream productivity low. She found that maximum flow for rainbow trout and

brown trout fry was 0.44 m³/sec. Maximum spawning habitat for rainbow trout was 0.8 m³/sec, while it was 0.74 m³/sec for brown trout. Optimum useable area for both species fell between 0.4 m³/sec and 0.8 m³/sec.

Flow in Little Last Chance Creek was too low during the winters of 1991 through 1996 (Table 3). Flows during that period were usually 0.06 m³/sec. These low flows may have promoted anchor ice formation and acted to limit trout survival in Little Last Chance Creek. Flows for fry rearing in summer were relatively high and limited useable rearing habitat and food production. Spawning flows for rainbow trout in the spring were favorable from 1991 through 1994, but too high from 1995 through 1997. Spawning flows for brown trout in fall limited available spawning area to less than one percent of available habitat from 1991 through 1994. Brown trout spawning flows improved in 1995 through 1997 to three to four percent of available habitat.

Although we can not correlate streamflow with trout biomass or standing crop in this study because of the intermittent influx of planted trout (Table 3), we can still comment on observed trends. Numbers of young trout (age 0+ and 1+) equalled or exceeded preproject levels from 1993 through 1997. Older trout were more abundant from 1994 through 1997 (Table 5 and Table 7). These increases generally correspond with the increase of flows during the summer and fall (Table 9). The failure of brown trout to flourish in 1991 and 1992 (Table 2) was due to very low winter flows coupled with extremely low flows in the fall (Table 9) during spawning. The failure of rainbow trout to reproduce during 1991 through 1994 was due to the failure of DFG planted trout

to survive long enough to spawn, in combination with Frenchman Dam not overflowing during those years. Trout from the lake enter the creek when the dam overflows.

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APPENDIX 1

PERMANENT FISH POPULATION STATIONS FOR LITTLE LAST CHANCE CREEK, PLUMAS COUNTY

Station 1 - Located 1.6 km below Frenchman Dam just downstream from the first bridge at elevation of 1659 m MSL in NW 1/4 of NE 1/4, Section 4, T23N, R16E. This station begins in a riffle beneath the bridge carrying Frenchman Lake Road, then enters a pool with a deeply undercut room-sized boulder on the right bank. The remainder of the station is a short riffle and a shallow pool/run. About 55 percent of the station is pool and 45 percent riffle. Substrate is boulder, rubble, and sand. The station is 47.9 m long with a surface area of 244.3 m² at a flow of 0.4 cms.

Station 2 - Located 3.2 km below Frenchman Dam adjacent to the upper end of a large turnout at an elevation of 1610 m MSL in NW 1/4 of SW 1/4, Section 3, T23N, R16E. This station begins in a large plunge pool followed by two shallow pool/run areas and two short riffles. About 45 percent of the station is pool and 55 percent riffle. Substrate is boulder, rubble, and sand. The station is 47.6 m long with a surface area of 271.3 m² at a flow of 0.4 cms.

Station 3 - Located 4.4 km below Frenchman Dam adjacent to the cutoff road in the center of Chilcoot Campground at an elevation of 1561 m MSL in NE 1/4 of NE 1/4, Section 10, T23N, R16E. This station begins in a steep rapid followed by a long pool with undercut right bank, then a short riffle, a short pool, and finally, another steep riffle. The station is 40 percent pool and 60 percent riffle. Substrate is boulders, rubble, and sand. The station is 46.6 m long with a surface area of 256.3 m² at a flow of 0.4 cms.